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A Conceptual Framework for Electronic Knowledge Delivery: A Contingency Approach for Achieving Learning Outcomes

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Abstract

*The integration of information technology into the learning process potentially affects the delivery of education in formal settings such as universities as well as the delivery of training in industrial settings. This paper presents an Electronic Knowledge Delivery (EKD) Framework, a contingency framework that integrates research streams in information technology and learning by exploring how information technology may support learning outcomes. Major components of the framework include **technology vision**, **technology capability**, **IT supported learning process**, and **learning outcomes**. The framework is applied to the emerging concepts of electronic markets for learning and performance support systems.*

Introduction

Academia and industry are exploring uses of information technology (IT) to support learning processes in the classroom and the work place. While this common theme is occurring within both the domains of academia and industry, research into the relationship between IT and learning thus far has been rather disjointed. The integration of information technology into the learning process potentially affects the delivery of education in formal settings such as universities as well as the delivery of training in industrial settings. A mechanism for integrating common constructs across these domains that would serve to focus a program of research has not been proposed.

This paper presents an Electronic Knowledge Delivery (EKD) Framework that is intended to bridge this gap. The objective of this paper is to propose a contingency framework, linked to theoretical underpinnings that integrates research streams in information technology and learning by exploring how information technology may support learning outcomes. The paper reviews supporting background literature, presents the EKD Framework, and applies the framework to recent industrial and educational developments.

Background Literature

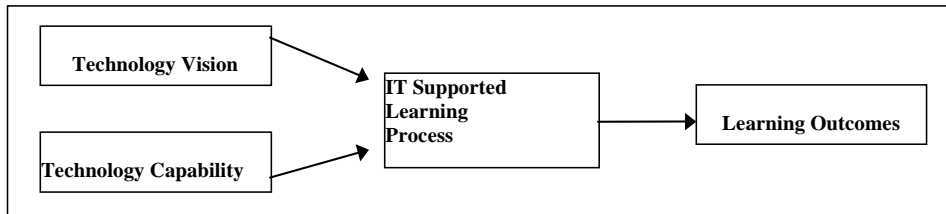
A review of the literature identified three areas of research that address the relationship between information technology and learning. The first area of research addresses the impact of learning on the use or effectiveness of information systems. This line of research focuses on learning as a factor in the performance of newly developed or existing information systems (Simon, Grover, Teng, & Whitcomb, 1996). A consistent finding is that the training of information system users is a significant factor in determining the success or effectiveness of the information system. (Alavi & Joachimsthaler, 1992; Yoon, Guimaraes, & O'Neal, 1995)

A second area of research addresses the use of information systems to support the process of educating or training people. Recent literature in this area has moved beyond merely describing the mechanics of designing and implementing these systems to examining the theoretical underpinnings of the learning process as presented in the literature of other disciplines (Stohr, 1995). Theories in the field of education and psychology support a number of approaches to the delivery of education and training. The information systems research community has begun to integrate these learning theories into information systems research, but results are few and clearly not definitive (Leidner & Jarvenpaa, 1995).

The third area of research focuses on delivery of "just-in-time" knowledge to both improve job performance (Cole, Fischer, & Saltzman, 1997; Gery, 1991) and deliver educational products (Hamalainen, Whinston, & Vishik, 1996). Industry has touted performance support systems as a way to drastically reduce formal training requirements and associated costs (Dublin, 1993; Perelman, 1994). The promises of these performance systems, however, have yet to be shown through a program of research.

There is a need for a framework from which to develop a program of research on the use of information technology to achieve learning outcomes in both the areas of academia and industry. The Electronic Knowledge Delivery (EKD) Framework presented in this paper focuses on the cognitive outcomes of the learning process. While there are other process outcomes that affect user attitude and behavior, they are not the focus of this framework. Figure 1 presents the EKD Framework. The framework consists of four constructs. An organization's *technology vision* and *technology capability* both affect the potential approaches to an *IT supported learning process*. The organization's IT supported learning process affects the level of an

individual user's cognitive *learning outcomes*. Each of the constructs in the framework will vary along their respective continua thereby providing a number of possible approaches to the achievement of learning outcomes.



**Figure 1. Conceptual Electronic Knowledge Delivery Framework:
A Contingency Approach for Achieving Learning Outcomes**

Technology Vision

Technology vision focuses on the effects of technology desired by the organization. This construct refers to the potential impact technology has on the use of information in an organization. The effects of technology range from *automating*, to *informating* (Zuboff, 1988), to *transforming* (Schein,

1992). These desired effects of technology on the use of information might require varied means to deliver knowledge. Information technology may provide a means to automate a current manual process - using PowerPoint slides to replace writing on a blackboard. A system may provide more feedback up the hierarchy - using electronic response pads, which informs up from student to teacher. The system may also facilitate student exploration in a non-linear manner - using the Internet in a discovery mode, which informs down. At the most complex level, virtual classrooms may transform the entire delivery process by allowing collaboration without the limitations imposed by time-space constraints (Leidner & Jarvenpaa, 1995).

Technology Capability

Technology capability of an organization lies along a spectrum derived from the capability maturity model, a measure of organization's software process maturity. The model consists of five levels. Each level represents an increasing level of maturity ranging from an ad hoc chaotic software development process to the highest level, a state of continuous process improvement (Herbsleb, Zubrow, Goldenson, Hayes, & Paulk, 1997).

IT Supported Learning Process

The IT supported learning process implements a learning model derived from any one or a combination of competing theories of learning. *Objectivism*, based on the behaviorist model (Skinner, 1953), portrays passive learners in need of a well-structured curriculum (Fosnot, 1995) that is delivered to the student (Leidner & Jarvenpaa, 1995). The *cognitive information processing* model focuses on instructional processes affecting individual cognition such as frequency, pace of instruction, and learner feedback (Brunning, 1983). The *constructivist* model focuses on environmental perceptions as students learn through adaptation (von Glaserfeld, 1995). *Collaborativism* is a model focusing on learning through interaction and shared understandings, placing the instructor in the role of discussion leader (Leidner & Jarvenpaa, 1995). The *sociocultural* model of learning focuses on interaction with cultural values and distortions of knowledge derived from other cultures (Leidner & Jarvenpaa, 1995).

Learning Outcome

The fourth element in the EKD Framework is the learning outcome of an individual, which is the result of the IT supported learning process. Bloom's taxonomy of objectives (Bloom, Englehart, Furst, Hill, & Krathwohl, 1956) is used to represent the spectrum of individual cognitive ability. The hierarchy of learning type begins at the *knowledge* level, which involves only recall of facts, terms, and methods. Intermediate levels include: *comprehension*, knowledge at an elementary level; *application*, dealing with abstraction of rules from knowledge; *analysis*, in which structure or organization is determined from sets of ideas; and *synthesis*, which focuses on derivation of new plans from parts of old plans. The highest level is *evaluation*, the level at which criteria based judgements are made.

Contingency Approach

The EKD Framework is based on a contingency approach. The usefulness of the EKD Framework in the near term is as a basis for a program of research to discover the effectiveness of various combinations of these constructs. Given the results currently reported in the research literature, there is a need to determine the best way or ways to use information technology to achieve desired learning outcomes. At the outset, one should not assume that the highest level of learning outcome is always desired. A lower-level cognitive ability may be sufficient for a worker to perform a simple task or for a student to appreciate a fact or concept tangential to the major area of study. On the other hand, the performance of some complex tasks by a worker or the achievement of a major learning objective in an educational setting may require a high level of cognitive ability. A required level of cognitive activity may better be achieved under different combinations of technology vision and IT supported learning processes. The learning outcome cannot be achieved however, if the organization does not possess a level of organizational IT capability to support the process.

The various levels of organizational IT maturity reflect the need for continuous organizational support of the learning process. As the rate of change in today's business environment continues to increase, organizations must be able to integrate and maintain information technology within and across many systems. This requires a level of capability that is reflected in the technology capability in the EKD Framework. It may be that a state of equifinality exists within the EKD Framework. Several combinations of vision, capability, and process may potentially produce equally acceptable learning outcomes. This is an area in need of further research.

Application of the EKD Framework

The EKD Framework is useful in developing research in delivering education and training in academic and industrial settings. Hamalainen et al. (1996) proposed the delivery of just-in-time knowledge delivered through electronic markets for learning. They suggest combining electronic commerce with knowledge delivery to create "virtual universities." These learning systems have the capability to rapidly develop and deliver customized training or more formal conceptual education through education brokerages operating via the Internet. The EKD Framework is a useful tool in addressing the contingency nature of the task. Required courses delivered by education brokerages must focus on a wide range of individual learning outcomes. These outcomes should be achieved through application of an appropriate learning model and support a vision agreed to by the user and broker. The broker's ability to repeatedly compose up-to-date component-based courses on demand requires a high level of technology capability. The EKD Framework provides a basis for evaluating the capabilities to implement robust education brokerages.

The idea of performance support presented in the literature is based on the integration of learning with the work task (Gery, 1991). In this context, the learner is responsible for job performance as well as required learning. The requirements of the job, the task, or the learner can be used to define the application of appropriate learning models. For example, help systems aimed at specific knowledge-level cognitive ability outcomes may need to provide simple presentations, deliver interactive multimedia supported training, or immerse the learner in a virtual environment through simulation. The capabilities of the system to deliver highly task specific training and support multiple learning models in dynamic environments certainly requires a high level of technology capability.

Conclusion

The separation of the delivery of formal education in a university setting and performance support systems is becoming less clear as demonstrated by the notions of education brokers and performance support systems. The EKD Framework integrates a parsimonious set of constructs, each of which has a firm underpinning in the literature. The EKD Framework acknowledges the immaturity of research in the area and takes a contingency approach to the specific combination of constructs required to achieve specific learning outcomes. The framework is useful for the analysis of systems being developed in both academia and industry and is broad enough to encompass the convergence of constructs within these domains.

References

References available on request from author.